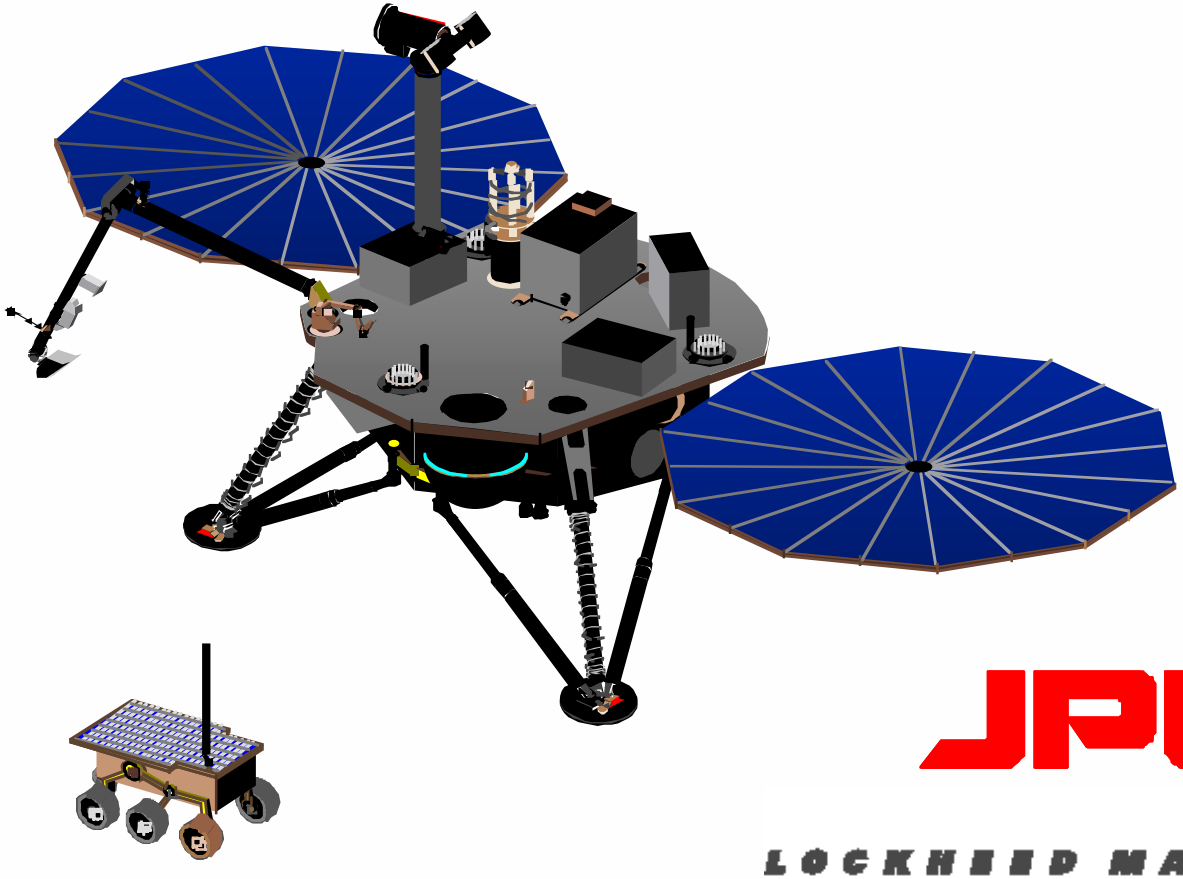
This material is intended to aid Mars Scout AO proposers in determining whether the partially completed Mars '01 lander can be of use in their investigation. The material is assembled from various sources. Proposers requiring further information should contact:
Steve Matousek, ph (818)354-6689, email: steven.e.matousek@jpl.nasa.gov

Proposers are advised that a Lander platform originally planned for use in an earlier version of the 2001 lander mission is in bonded storage as the property of NASA and can be made available as Government Furnished Equipment (GFE) to proposers to this Mars Scout solicitation. Proposers who may want to use this item are advised that NASA is offering it on equal terms "as is." Anyone proposing its use shall: 1) assume complete responsibility for its utilization; 2) ensure that, if used, it will be flight qualified for its specific proposed flight configuration; 3) provide complete technical discussion in their proposal of the approach and concept for its modification (if required), development, and flight as would be required for any other proposed flight hardware; and 4) ensure that any and all costs associated with its utilization are accounted for and included in the proposal.

Note: Proposers must use the entire Lander platform. No partial use of the Lander components and subassemblies is allowed (for example, use of only the lander aeroshell is not allowed).

MSP'01 MARS LANDER STATUS, Aug '01



JPL

LOCKHEED MARTIN

Contents

Summary Assessment

Background

The Mars 2001 Lander Mission followed on the launch of the Mars 1998 Lander mission as a derivative of the '98 basic design.

The science payload was selected to further the understanding of the evolution of the surface of Mars and increase understanding of the Mars environment 's effects on equipment and living organisms. The payload consisted of :

- **A Rover (Identical to the Mars 1996 Rover)**
- **A Robotic Arm With Several End Actuator Experiments**
- **A Mars Environmental Compatibility Assessment Instrument**
- **A Stereo Imager/thermal Spectrometer**
- **A Radiation Sensing Experiment**

The 2001 Lander mission was comprised of a cruise stage plus Lander; designed to use the cruise stage for electrical power and as a communication port during cruise. This cruise stage would be jettisoned prior to entry to the Mars atmosphere. The Lander, using an aero lifting body to "steer" through the atmosphere, would then jettison the heat shield and deploy a parachute. When the entry speed was sufficiently reduced and the Lander was approximately one kilometer above the surface, the parachute would be jettisoned and the descent phase would continue until touchdown using thruster control. The Lander used three legs with shock absorbing capability to affect a soft landing on the surface. Once on the surface, the science phase would begin after the solar array was deployed and the rover deployed to the surface. Surface operations would last between 90 to 140 Mars days (depending on landing site, slope, dust storm severity).

The 2001 Lander was assembled and in system test when the failure of the '98 Lander lead to the storage of the 2001 Lander.

Summary Assessment

Storage of the 2001 Lander

The failure of the 1998 Lander to communicate with earth resulted in a reevaluation of the 2001 Lander. The 2001 Lander Project evaluated the findings of the '98 failure review boards and conducted an internal risk assessment/risk reduction study. The study yielded several areas where design enhancements could improve mission success in addition to correcting the most probable cause of the '98 failure. The proposed improvements were not compatible with a 2001 launch opportunity and the Lander and payload were put into storage.

Lander Improvements

Keys areas of improvement opportunity were examined in the following areas:

1. Communication - Improve communication with "direct to earth" X-band capability - the original design conducted all communication via a UHF relay through Mars orbiters. Provide for improved communication during the entry,descent, and landing phase - the original design had no communication in this period. Although not strictly affecting the reliability of this mission, the knowledge returned would be of high value to succeeding missions.

2. Landing improvements - Improve the strength/shock absorbing ability of the landing leg system to tolerate high speed landings. Improve the ability of the Lander to sense and measure distance to surface and closing speeds. Improve the control authority of the landing propulsion system.

3. Increase the test program with enhanced or improved: propulsion thruster tests, software stress testing, landing radar drop tests, high temperature arc testing of the heat shield.

At the time the Lander effort was stopped, key elements of all three areas had been achieved.

Summary Assessment

Lander Storage Status

This information package lists the state of all Lander hardware and software. With the exception of some of the telecommunication equipment, which were transferred to another NASA program, nearly all of the Lander is in storage. Equipment liens (example: an open PFR or the need to environmentally retest) is listed where applicable. Storage Cost ~ $10 K/Month

Lander Software Status

The software status is listed in this information package. The software used in the Lander is approximately 85% re-used from the MCO/MPL/Odyssey/Genesis/Stardust line of spacecraft. Of the 15% development, the Lander had completed about 50% through test at the time the Lander was placed in storage.

Science Payload Status

With the exception of the thermal spectrometer/imager instrument, which was transferred to the 2003 MER mission, the payload suite is in storage at the Jet Propulsion Laboratory and the Johnson Space Center

Science Payload Accommodation and Lander Improvements

The addition of a direct to earth link resulted in the addition of a small articulated antenna on the top deck. This addition of approximately 5 kg and the required space on the top deck, will result in the reduction of payload accommodation capability from the original payload suite.

EDL Overview

Pre-Entry Operations

- Communication Ops
- TCM - 5 Ops
- Thermal Operations
- Prep Prop System
- **Jettison Cruise Stage (E-5 min.)**

Dry Mass = 623 kg

Hypersonic Operations

- **Aeromaneuver**
- Power on Landing Radar
- Wait for Parachute Ops
- Dry Mass = 539.5 kg

Interface: sensed g = 0.03

Parachute Operations

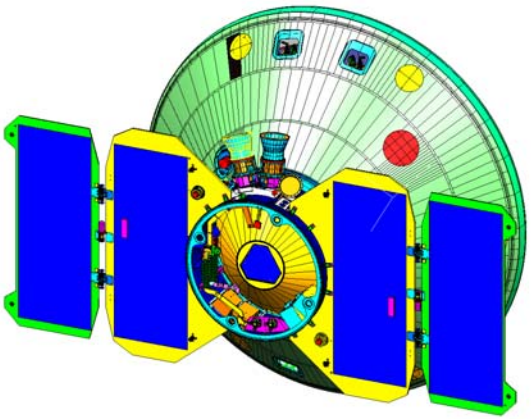
- **Deploy Parachute**
- **Separate Heatshield**
- **Deploy Legs**
- Activate Landing Radar
- Dry Mass = 468 kg

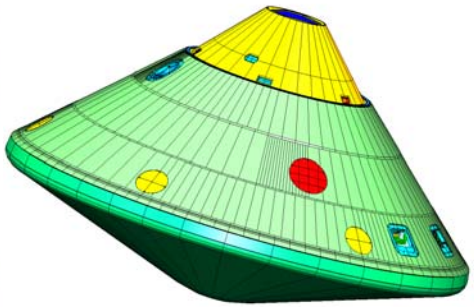
Interface: Calculated V = 503 m/s

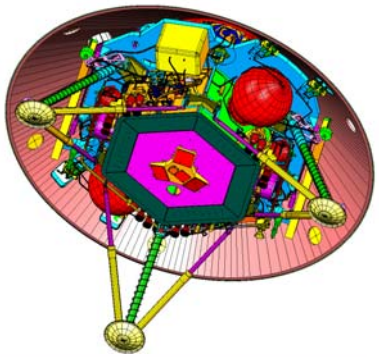
Powered Descent

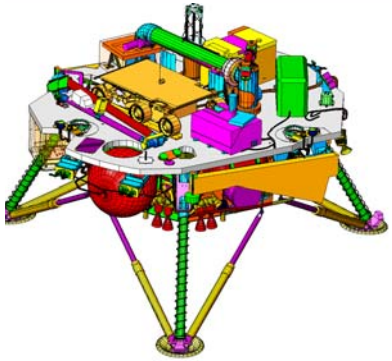
- **Lander Separation**
- Fire Descent Engines
- **Landing**
- Dry Mass = 346 kg

Interface: Nav computed alt/vel

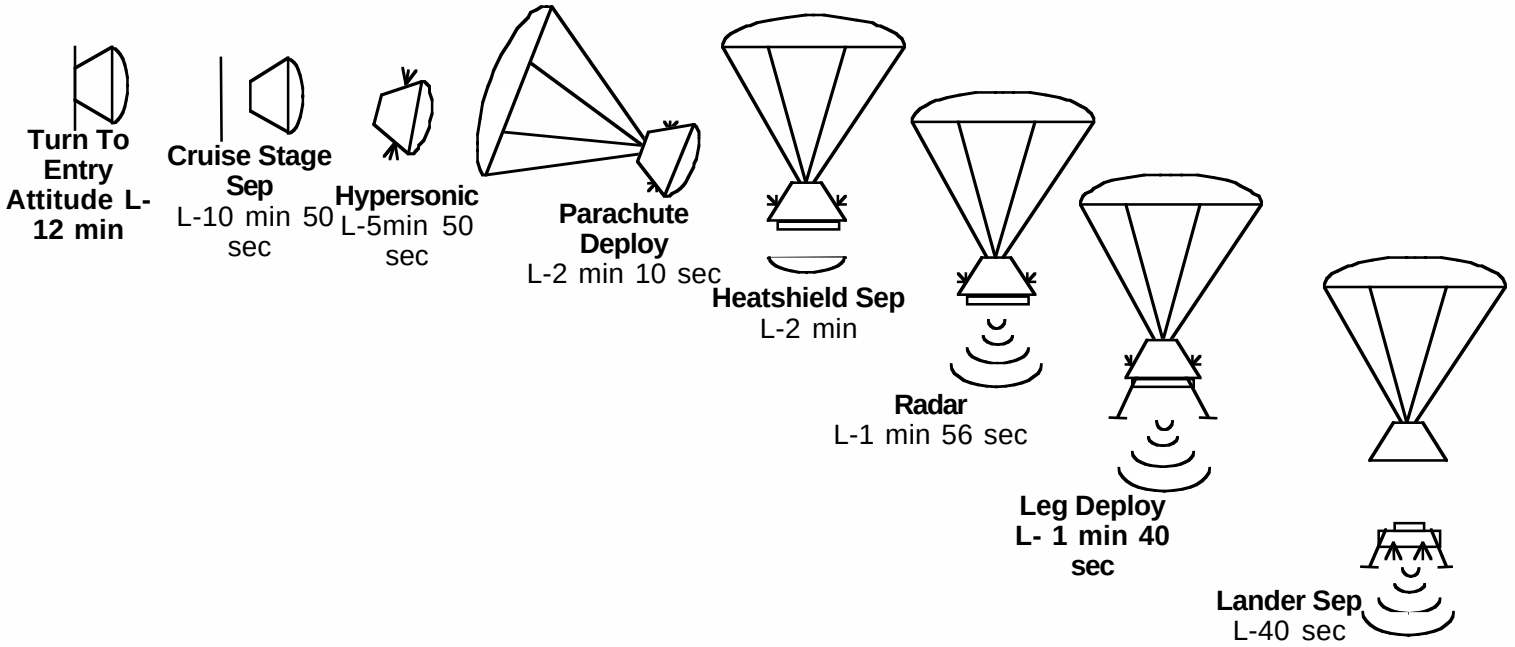








EDL Time Line



Radar Data Cutoff @ 40m L-34 sec

Landing

Lander Development Schedule

- **Phase A Initiated, 4/1997**
- **Phase B Initiated, 11/1997**
  - **PRELIMINARY SYSTEM DESIGN REVIEW 10/6/1998**
- **Phase C/D Initiated, 10/13/1998**
  - **CRITICAL SYSTEM DESIGN REVIEW 4/13/1999**
  - **Lander First Power-Up in ATLO, 11/16/1999**
  - **Direction from JPL to Revise the Lander Payload and Add a Direct to Earth Communication Capability (DTE), 1/2000**
    - » **Necessitated Reduced Payload to Accommodate DTE**
    - » **Original Lander Baseline was UHF Link only to either MCO or MSP01 Orbiter for X-Band Relay to Earth**
  - **Direction from JPL to Slip the Lander Beyond 2001 Launch Opportunity, 3/24/2000**
    - » **Original Planned Launch—April 2001**
- **Lander Storage Activities Completed, 8/2001**

System Level Lander Requirements

- **Lifetime:**
  - Minimum of 90 Sols Landed Operation Under Nominal Conditions
  - Able to Complete the 21 Sol Primary Mission After a Dust Storm(s) Lasting up to 20 Sols
- **Single Failure Tolerant**
  - Exceptions Defined by Project Policy
- **Launch Requirements:**
  - Maximum Lander Launch Mass ≤ 687 Kg (Assuming a 95% Launch Vehicle Probability of Commanded Shutdown)
  - Compatible With a NASA Provided Delta II 7425 With a 9.5 Ft Fairing
- **Arrival Conditions:**
  - V Infinity of the Lander Will Be Less Than 4.92 Km/s
  - Entry, Descent, and Landing (EDL) Analysis Shall Assume an Entry Flight Path Angle That Is ± 0.27 Degrees [3 Sigma] and ± 0.5 Seconds [3-sigma]

System Level Lander Requirements

- **Operational Capability**
  - **Capable of Landing at a Maximum Site Elevation of 2.5 Km**
  - **Landing Site Located Within the Latitude Band of 15 Degree S to 15 Degree N**
  - **Minimum Ground Clearance of 33 Cm to the Critical Hardware Locations**
  - **Able to Land and Operate Nominally on a Slope of up to 10 Degrees**
  - **No More Than 6 Degrees of Tilt Due to Leg Crush (i.e. Total Lander Tilt Is Assumed to Be Less Than 16 Degrees)**
  - **Designed to Operate Nominally With an Optical Depth of 0.5—For Dust Storms, the Lander Shall Assume an Optical Depth of 2**
  - **Design Analysis Shall Assume a Dust Degradation on the Solar Arrays of: $P = P_o E^{-0.003t}$, Where P = Power, P_o = Initial Power, and T = Time in Sols**
  - **Assume Surface Temperatures From 185 K to 275 K**
  - **Design not contingent on use of RHUs or RTGs (Not Precluded for Future Applications)**
  - **Direct-To-Earth (DTE) Communication Capability from Surface**
  - **UHF Link (Command and Telemetry) to Orbiting Asset from Surface**

Lander Design Capabilities

- Delta II LV Launch Compatible
- EDL Communication Capability
- Direct To Earth Communication: X-Band
- 50 Kg Payload Capability
- System Mass
  - Launch : 687 Kg
  - Entry : 585 Kg
  - Landed : 350 Kg (Dry)
- Approximately 16000 cm^2 Of Configurable Science Deck Area For Payload Mounting
- Approximately 500000 cm^3 Of Non-Contiguous Payload Volume Within Aeroshell

Lander Design Capabilities

- **Payload Power**
  - Cruise : Periodic Health Checks
  - Day : 175 W-hr
  - Night : 250 W-hr
- **Communication**
  - Cruise
    - » MGA: 100 bps (34m BWG)
    - » LGA: 40 bps (34m BWG)
  - EDL
    - » LGA: 1 Semaphore Every 10 Seconds (75 Total)
  - Landed Operations
    - » DTE: MGA: > 400 bps (34m HEF), LGA: 10b/s (70m)
    - » UHF: 128 kbps
- **Slope Capability : 10 Degrees (Options Exist to Increase To 20 Deg)**
- **Rock Clearance : 37cm (Options Exist To Increase To 50cm)**
- **TPS Thickness: 0.55”**

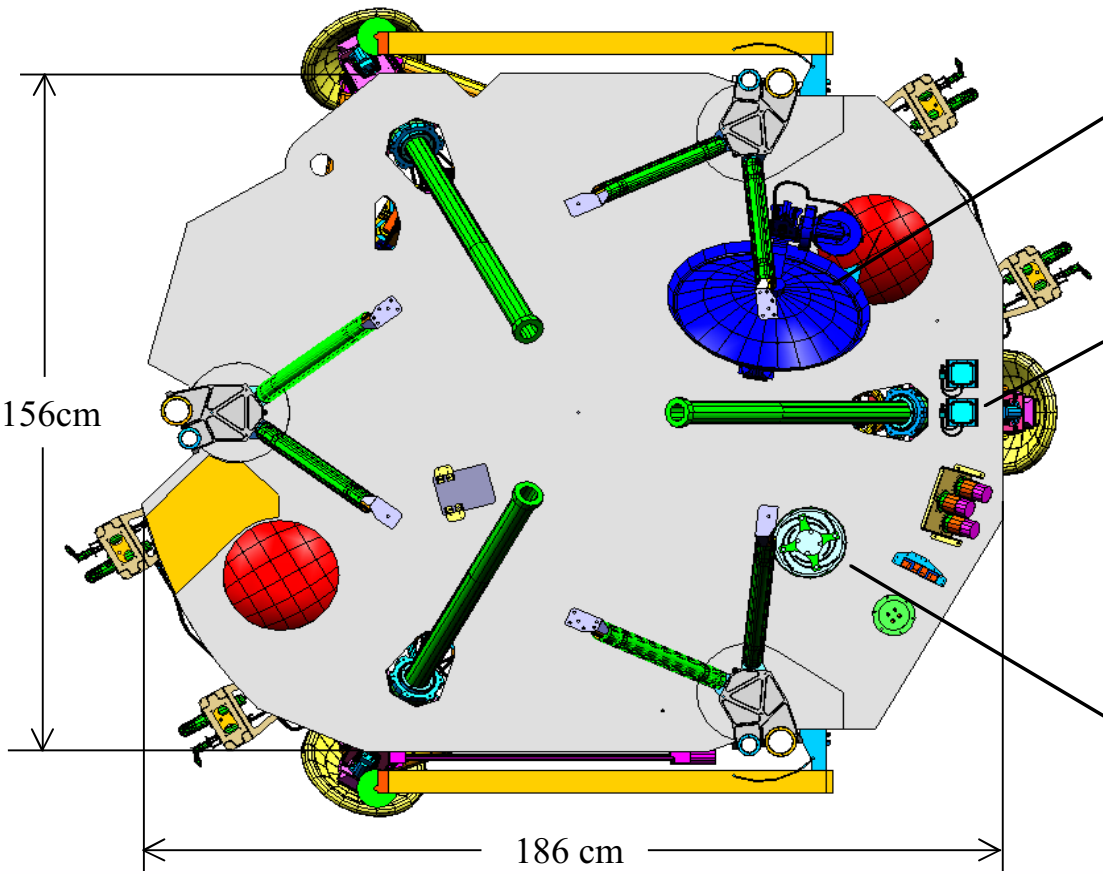
Lander Design Capabilities

- **Loads Environment**
  - Launch : 3.3g Axial, 4.3g Lateral
  - 3rd Stage Burnout : 9.0g Axial with 77RPM Spin
  - Parachute Snatch : 9.5g Axial
  - Entry : 14g Axial
- **Thermal Environment**
  - Pre Launch : 13˚C Fairing Air
  - T-10Hr To Launch : 22˚C Internal Aeroshell Air
  - Inner Cruise:
    - Backshell : -100˚C To +90˚C
    - Science Deck : -60˚C to 0˚C
  - Outer Cruise:
    - Backshell : -100˚C To 0˚C
    - Science Deck : -60˚C to 0˚C
  - Landed
    - Atmosphere: 182˚K to 277˚K - Wind : 2m/s to 20m/s
    - Surface: 180˚K to 299˚K
    - Science Deck: -85˚C to +40˚C

Lander Payload & Communication Accommodation

Antenna Locations Can Be Modified To Optimize Payload Capability

Approximately 16000 cm^2 of Payload Mounting Area On Science Deck



Narrow Beam, Gimbaled, Direct-To-Earth Antenna

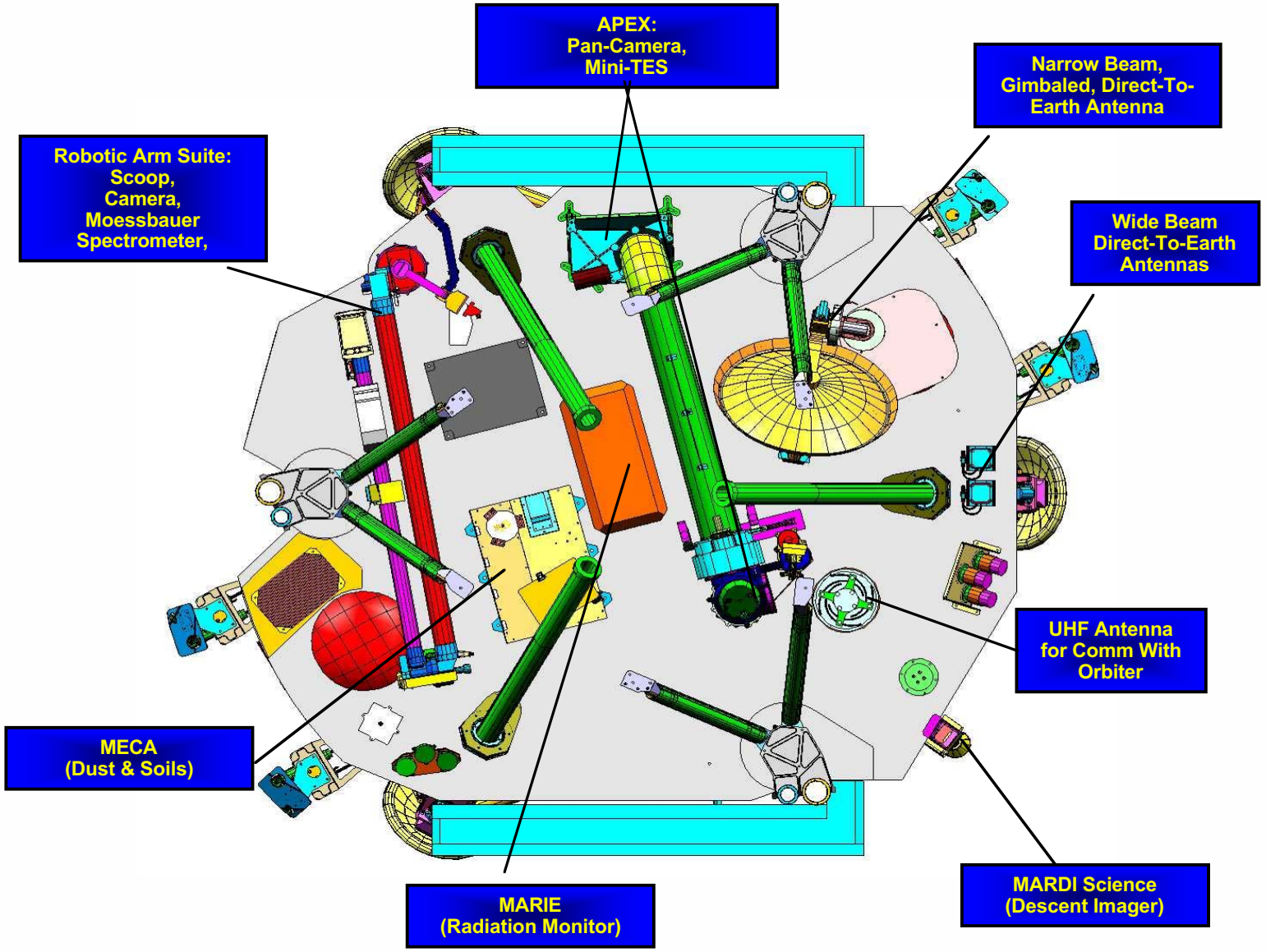
Wide Beam Direct-To-Earth Antennas

UHF Antenna for Comm With Orbiter

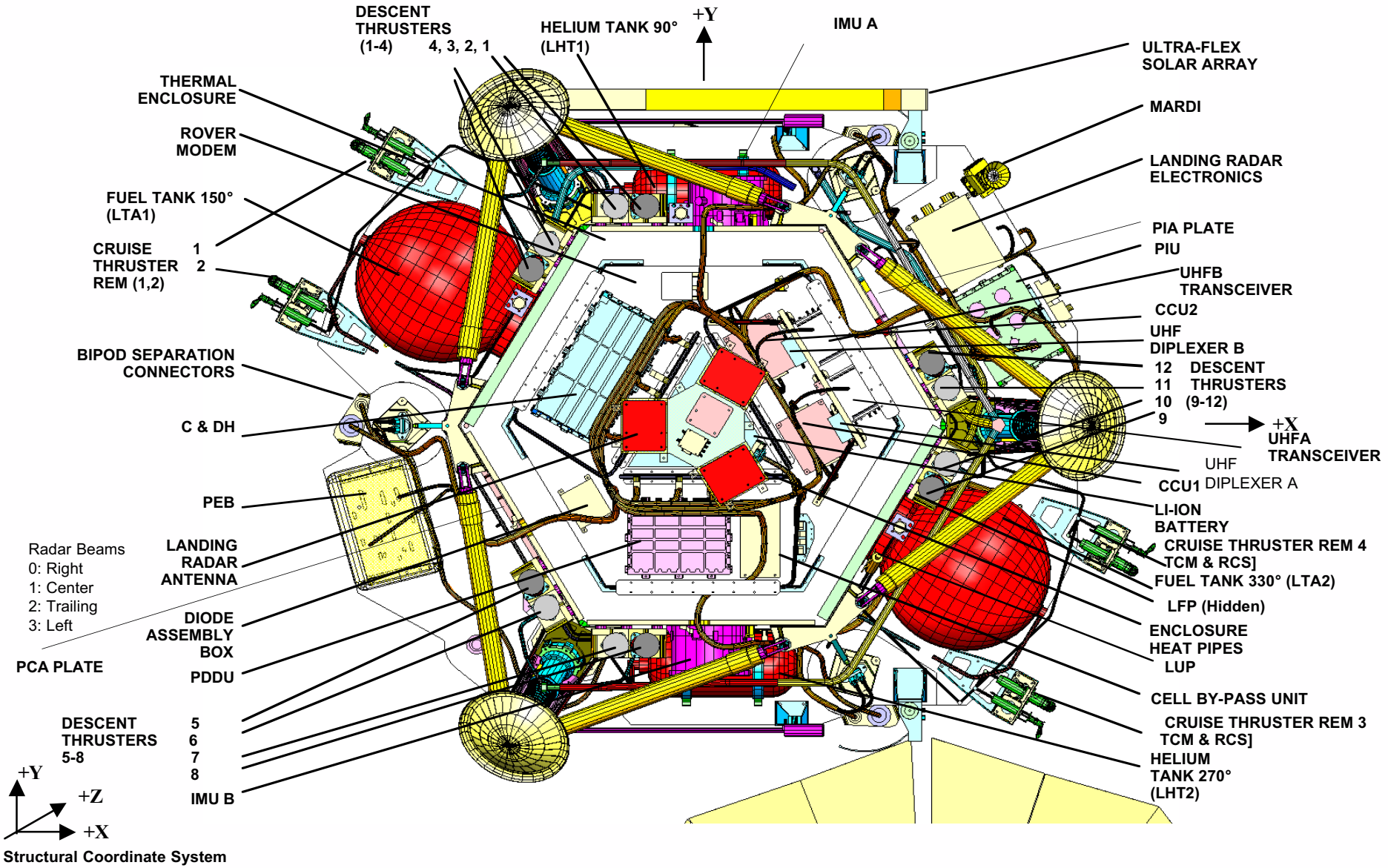
Approximately 500000 cm^3 of Non-Contiguous Payload Volume Available

Science Deck Inserts Can Be Installed To Accommodate A Wide Variety Of Payloads

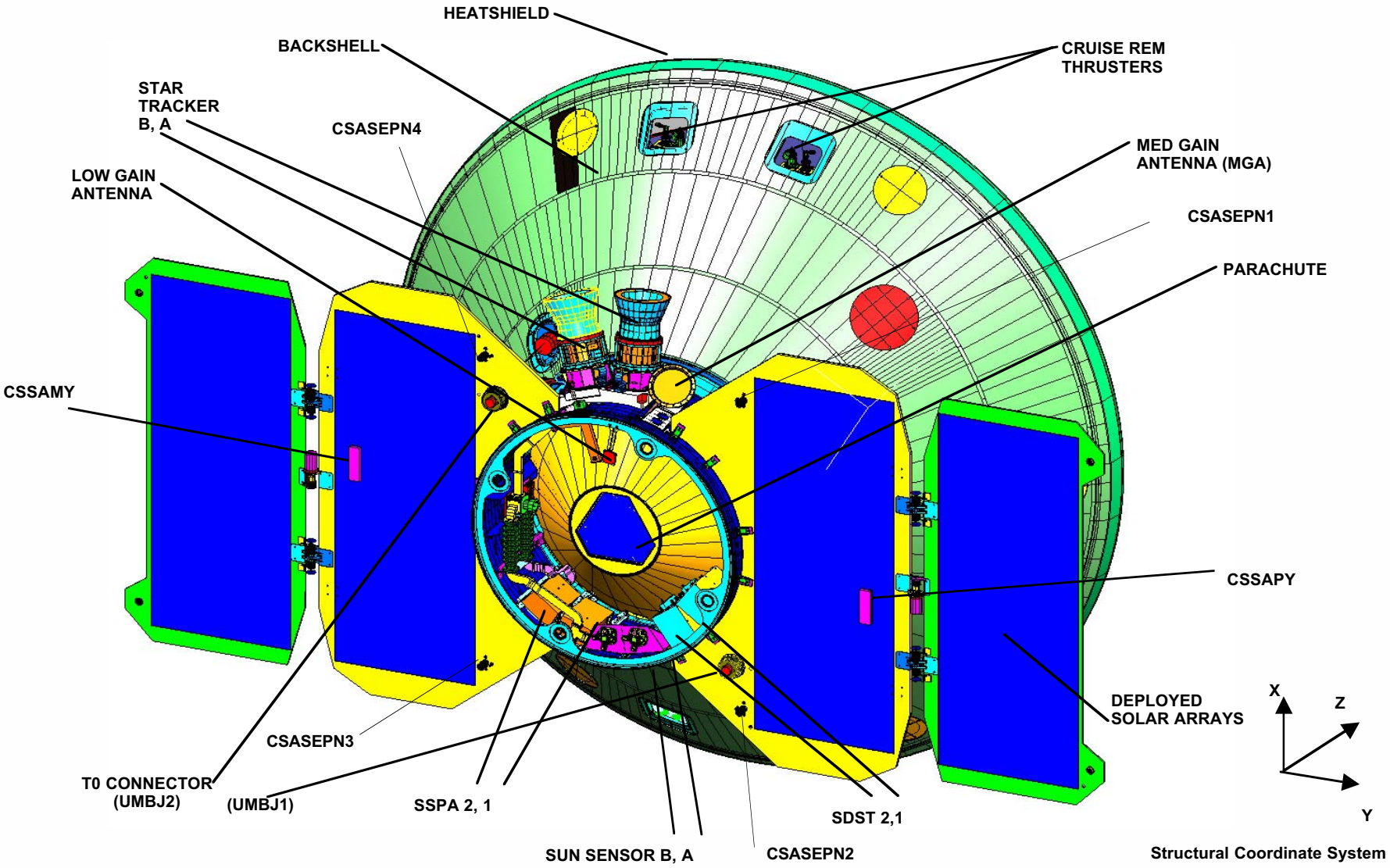
Example Payload Suite With Direct To Earth Comm



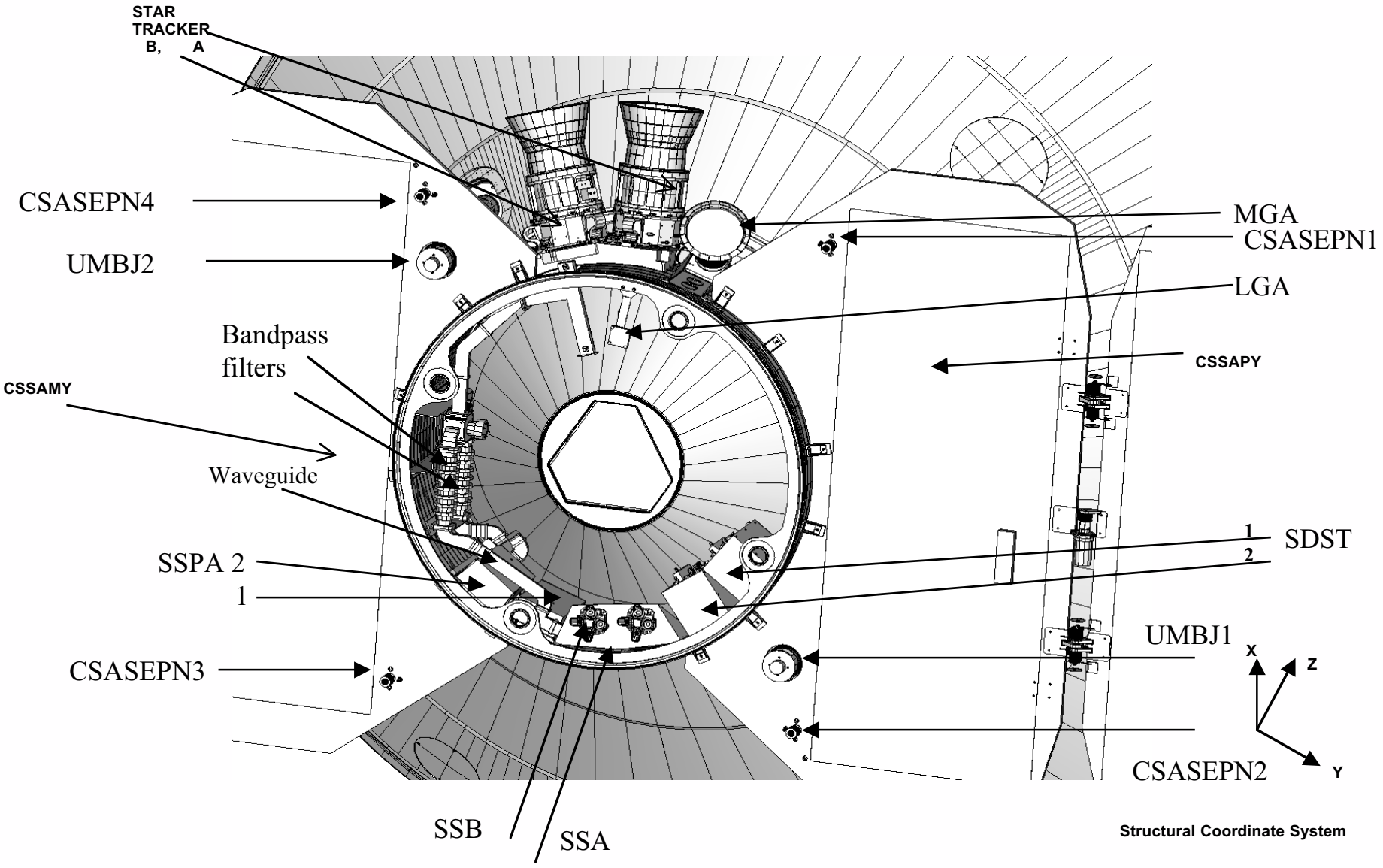
Component Deck & Exterior Equipment Layout



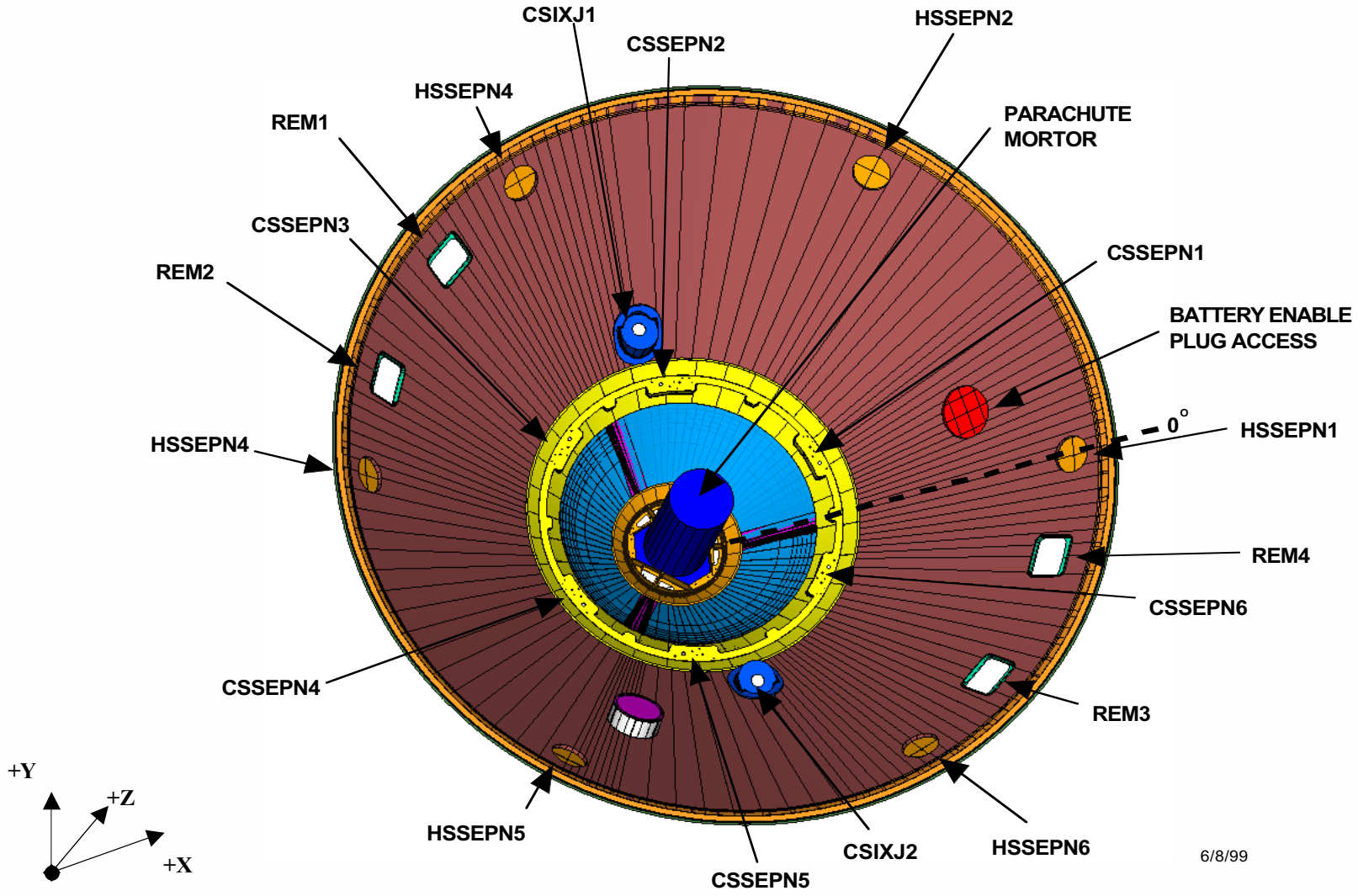
Cruise Configuration



Cruise Stage



Backshell Configuration

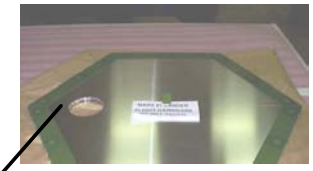


Structural Coordinate System

Exploded View of Lander Cruise Configuration

Heatshield Layup

Enclosure Cover



Backshell Layup

Science Deck

Cone Parachute Ring

Equipment Enclosure

Backshell Ring

Cruise Stage LV I/F Ring

Cruise Solar Arrays

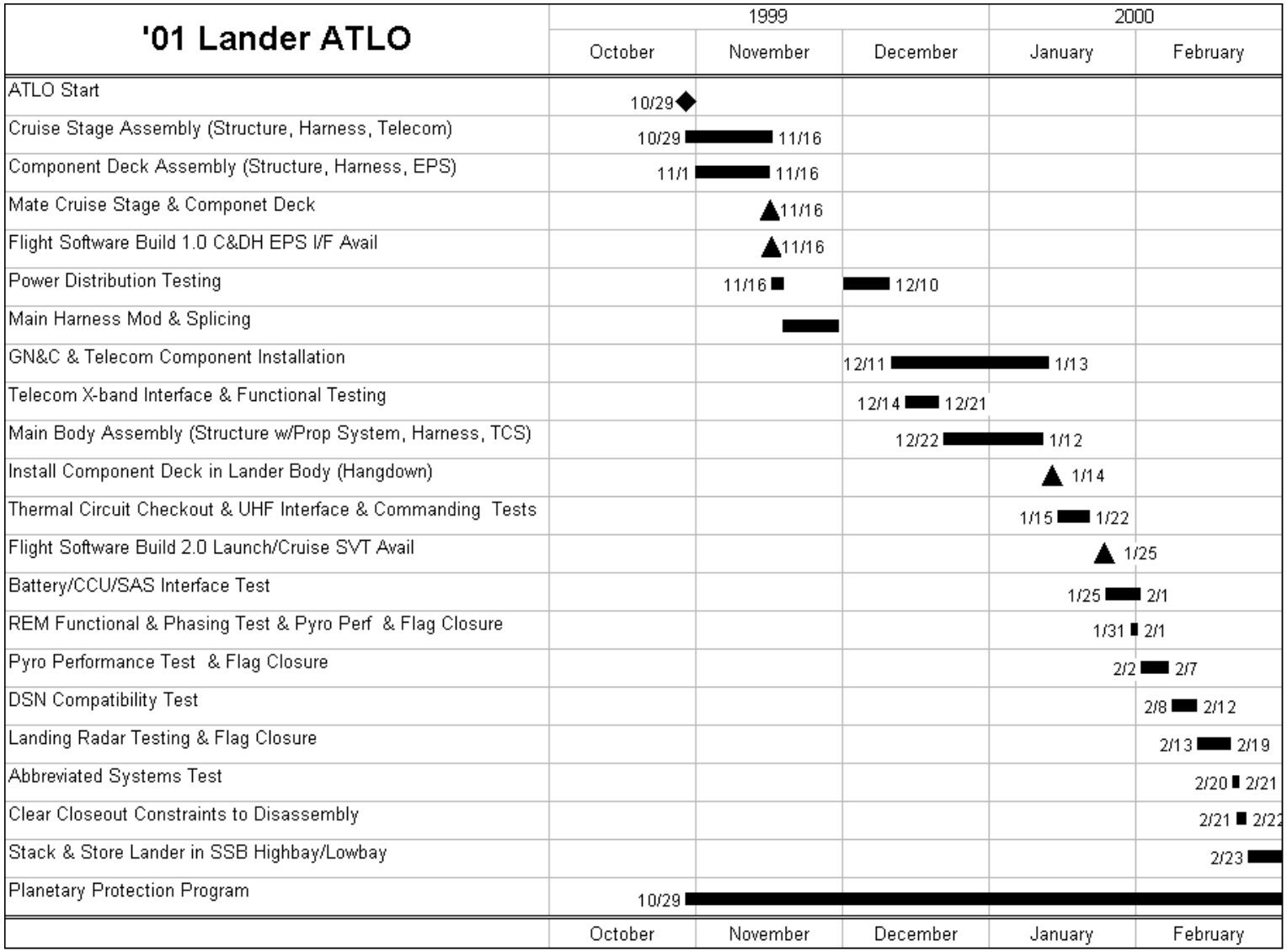
Lander ATLO – Completed Activities

- **Assembled Structural Elements**
  - Cruise Stage Harness and Telecom Components
  - Component Deck: Installed Harness & Avionic Components & Test Batteries
  - Installed Component Deck Onto Lander Body
- **Subsystems Installed and Functionally Tested**
  - Propulsion Subsystem
  - EPS (Harnesses, PDDU, CCU, PIU, Diode Assy, CBU and Thermal & Test Batteries)
  - C&DH
  - Telecom (Cruise SDSTs, SSPAs & X-band System and UHF EDU, Less Antennas)
  - GN&C (IMUs, Sun Sensors, Landing Radar and Star Tracker EDU)
  - Thermal (Component Deck & Cruise Stage Heater Circuits)
  - Flight Software (Builds 1 & 2)

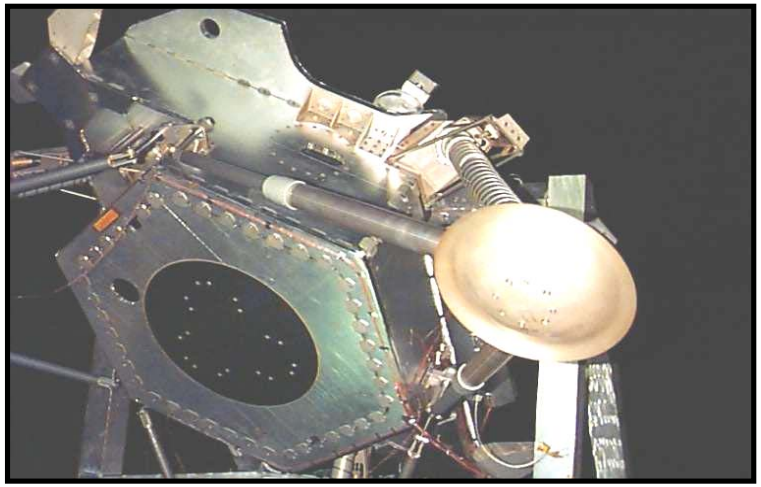
Lander ATLO – Completed Activities (Concluded)

- **Major Tests Performed**
  - Bus Functional Test
  - Battery/CCU/Solar Array Simulator Interface Test
  - REM Functional & Phasing Test
  - Pyro Performance Test
  - Abbreviated System Test #1
  - DSN Compatibility Test
  - Landing Radar Test

Lander ATLO As-Built/Tested Schedule

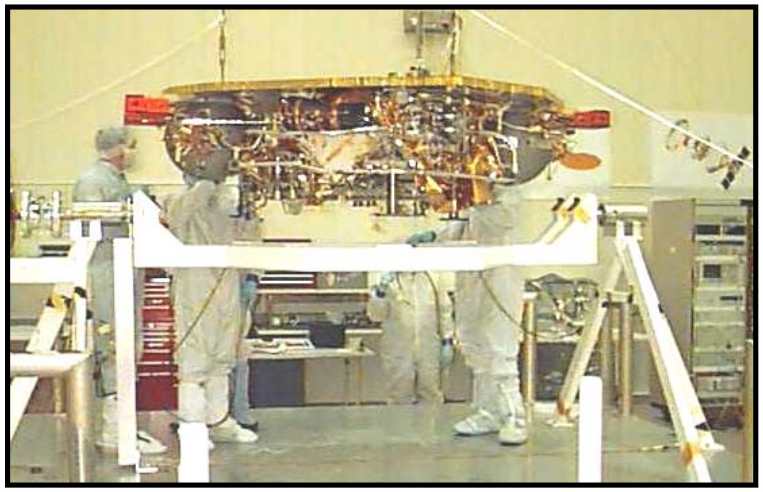


Lander ATLO Photo Gallery

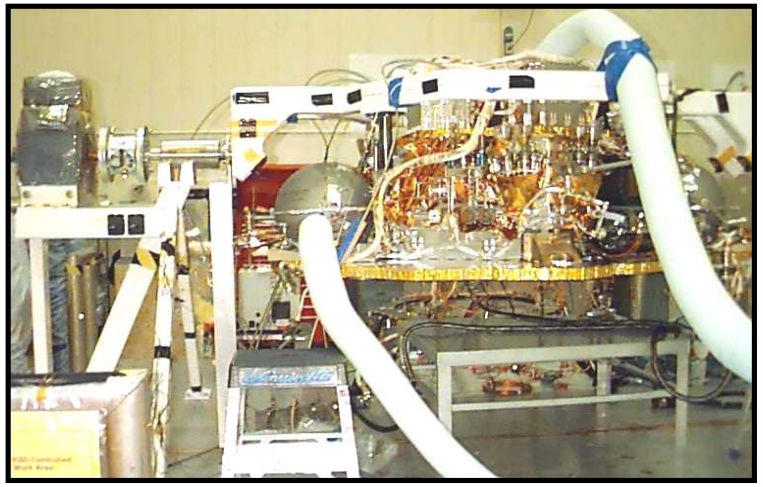


Lander Legs In Test

Lander Component Deck Installation



Lander Body Lift to Rotation Fixture



Lander Powered-On Testing

Entry Body Photo Gallery

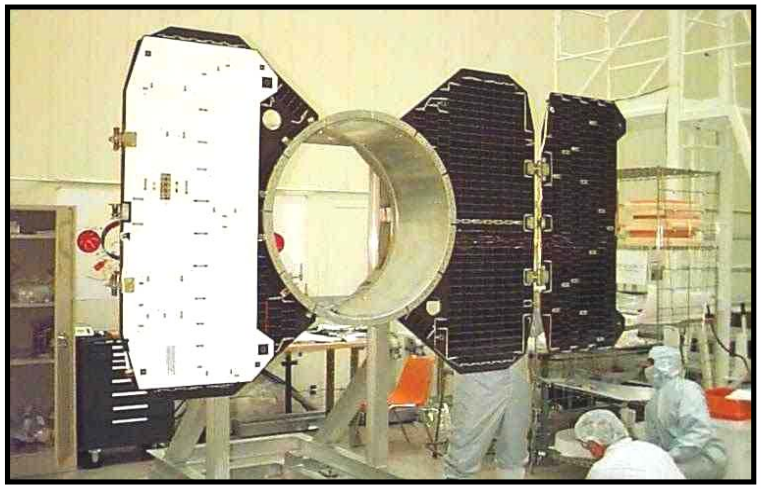
Lander Aeroshell (Pre-TPS)

Parachute Cone With TPS & Paint

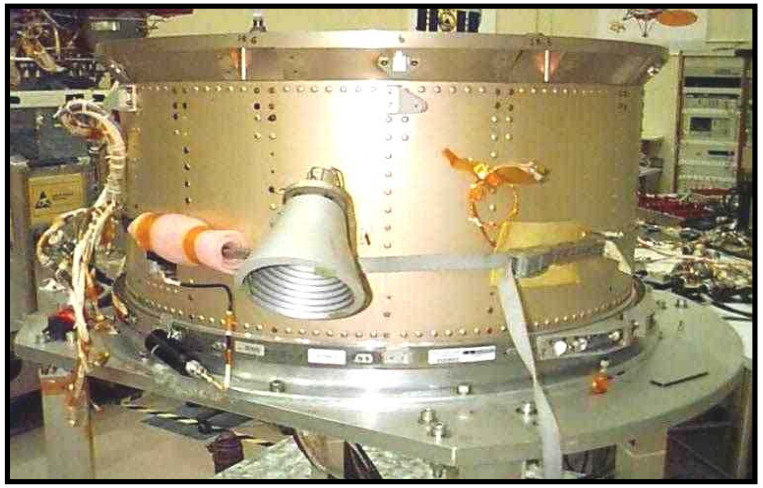
Backshell With TPS & Paint

Heatshield (Post-TPS)

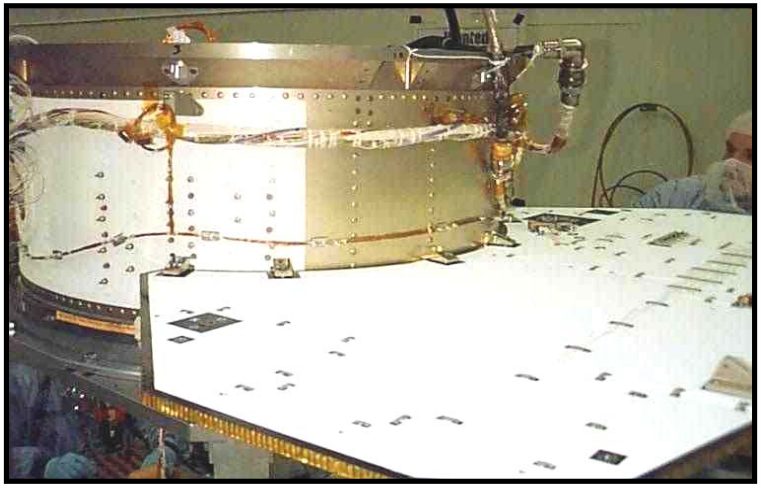
Cruise Stage Photo Gallery



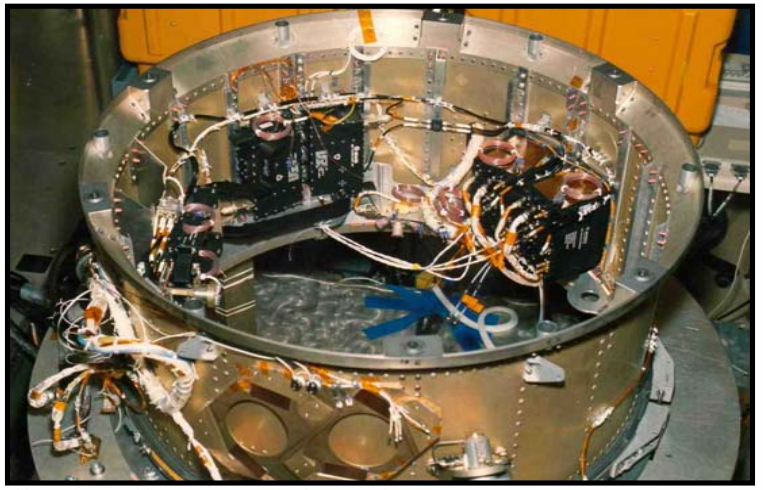
Cruise Stage Solar Array Deployment



Cruise Stage With MGA



Cruise Stage With Solar Arrays



Cruise Stage With Telecom Equipment

Lander Hardware Status

- All Lander Hardware Is Stored at Lockheed Martin Astronautics (Denver) Either in Special Stock Room (SSB Building, Room 97B), or in SSB Building High Bay Clean Room, or Installed on Lander Body Which Is in Storage Container in SSB Building High Bay Clean Room—Unless Otherwise Noted
- All Hardware Elements Are Complete, Functionally and Environmentally Tested, and Flight Ready, Unless Otherwise Noted
- Hardware Status is as of August 2001

Lander Hardware Status

SS	Part Number	Nomenclature	Quantity			Location	Comments
			Flt Rqd	Flt Avail	Spare		
C&DH							
C&DH	919L0120000-009	C&DH	1	1	-	Stockroom 97B	Needs Reassembly & ATP
C&DH	- 915A0916000-009	- Chassis	1	1	1	Stockroom 97B	
C&DH	- 180A432-1	- FPC	2	2	-	Stockroom 97B	SN 36: PIRS AE3390 Unverified Resets (Use as Is) & AG7514 Pending Solder Rework
C&DH	- 170100	- FMCA	2	2	-	Stockroom 97B	
C&DH	- AE-511817-02	- ULDL	2	2	1	Stockroom 97B	
C&DH	- 915A0201000-009	- MIO	2	2	-	Stockroom 97B	
C&DH	- AE-511717	- PACI	4	4	1	Stockroom 97B	3 Units OCA SCAM, 2 Units EMS Tracker
C&DH	- 20095709G1	- DCDC Conv.	1	1	1	Stockroom 97B	Spare: PIRS AF7911 Pending - Capacitors
C&DH	- 915A0303000-009	- CMIC	1	1	-	Stockroom 97B	PIRS AC9353 Dented Connector
C&DH	- 915A0803000-009	- Backplane	1	1	-	Stockroom 97B	
AACS							
AACS	YG9666BC	IMU	2	2	-	Installed	
AACS	HG958OAA	RADAR ELECTRONICS	1	1	-	Stockroom 97B	
AACS	YG1893AA01	RADAR	1	1	-	Stockroom 97B	
AACS	43730	SUN SENSOR	2	2	1	Stockroom 97B	
AACS	Q941A-1001-003	StarTracker	2	-	-	-	Not Fabricated, Spare Odyssey SCAM Avail
Harness							
Harness	919L3142004-009	Backshell Harness	1	-	-	-	Not Fabricated, Connectors & Material In 97B
Harness	919L3143004-009	Lander Main Harness	1	-	-	-	Removed, Connectors & Material In 97B
Harness	919L3143004-010	Lander Propulsion Harness	1	1	-	Installed	
Harness	919L3143004-019	Lander Pyro Harness	1	1	-	Installed	
Harness	919L3141004-009	Cruise Stage Harness	1	1	-	Installed	
Harness	919L3141009-001	Enable Plug	1	-	-	-	Not Fabricated
Harness	919L3141009-002	Enable Plug	1	-	-	-	Not Fabricated
Harness	919L3141009-003	Enable Plug	1	-	-	-	Not Fabricated

Installed Indicates that the Element is Installed on the Lander Body

Lander Hardware Status

SS	Part Number	Nomenclature	Quantity			Location	Comments
			Flt Rqd	Flt Avail	Spare		
EPS							
EPS	902B3145000-009	DESCENT REM DIODES	6	6	2	Installed	Spares In Stockroom 97B
EPS	915A1404000-019	Isolation Diode Assy	1	TBR	-	TBR	
EPS	919L3170000-009	PIU Top Assembly	1	1	-	Stockroom 97B	Assy & ATP Complete
EPS	- 915A0906000-009	- PIU Chassis	1	1	1	Stockroom 97B	Flight Units In PIU Assy
EPS	- 915A0806000-009	- PIU Backplane	1	1	1	Stockroom 97B	Flight Units In PIU Assy
EPS	- 915A1201000-009	- PVDM Card	1	1	1	Stockroom 97B	Flight Units In PIU Assy
EPS	- 915A1301000-009	- PIM Card	2	2	1	Stockroom 97B	Flight Units In PIU Assy
EPS	EAP-12137	THERMAL BATTERY	1	1	7	Installed	Spares In Stockroom 97B
EPS	AE-512394	CCU	2	2	1	SAI	Flt. Status TBR, Spare In Stockroom 97B
EPS	919L1500000-009	CBU	1	1	1	Stockroom 97B	PIRS AE1743: Power Supply Overstress
EPS	AE-516098	Diode Box	1	-	-	-	Modified For Orbiter - Need New One
EPS	LP30400	Li Ion BATTERY	1	-	-	-	Transferred To AFRL & LMA: OD 100-055
EPS	2007K0000	Lander Solar Array	2	2	-	HiBay	In Shipping Container - Needs ATP
EPS	919B0190000-010	PDDU	1	1	-	Stockroom 97B	Needs Reassembly & ATP
EPS	- 915A0904000-009	- Chassis	1	1	2	Stockroom 97B	
EPS	- 915A1101000-009	- MAD	1	1	-	Stockroom 97B	
EPS	- 20095709G2	- HEPS	1	1	-	Stockroom 97B	
EPS	- 915A0302000-009	- EMIC	1	1	1	Stockroom 97B	
EPS	- 915A0402000-009	- RPC	2	2	1	Stockroom 97B	
EPS	- 915A0401000-009	- PDC	2	2	2	Stockroom 97B	One Spare Needs PSMs -PIRS AF5145
EPS	- 915A0202000-009	- Dual Slave	1	1	1	Stockroom 97B	
EPS	- 915A0804000-009	- Backplane	1	1	1	Stockroom 97B	
EPS	AM111369-001	Cruise S/A Top Assembly	1	1		HiBay	In Shipping Container

Installed Indicates that the Element is Installed on the Lander Body

Lander Hardware Status

SS	Part Number	Nomenclature	Quantity			Location	Comments
			Flt Rqd	Flt Avail	Spare		
Telecom							
Telecom	184950-2	UHF Helix ANTENNA	1L	1	-	Stockroom 97B	Protoflight Antenna - Needs Re-ATP
Telecom	Various	RF Cable & Connector	1L 1CS	- 1CS	-	- Installed	Lander Cables Not Complete CS Cable Installed
Telecom	648590-1	UHF TRANSCIEVER	1L	-	-	-	Transfered To MER : OD 100-056
Telecom	D-UHF-1011	UHF DIPLEXER	1L	-	-	-	Not Completed
Telecom	01-P43320N001	SDST	1L 2CS	-	-	-	Transfered to JPL Block Buy : OD 100-054, 600-003
Telecom	Various	Waveguide	1L 1CS	- 1CS	-	- Installed	DTE WG Not Complete CS WG Installed
Telecom	1062717	WG Adapter	2L 1CS	- 1CS		- Installed	
Telecom	119243-103	RF Transfer Switch	1L 1CS	1L 1CS		Stockroom 97B Installed	
Telecom	184260-4	SSPA	3	-	-	-	Transferred To SIRTF: OD 630-032
Telecom	919L3205200-009	LGA MOUNTING Assy	1CS	1		Installed	
Telecom	919L3355309-002	Atttenuator Kit	1L	1		Stockroom 97B	
Telecom	D-X-1009	Diplexer Xband	1L 1CS	- 1CS	-	- Installed	Lander Unit Xferred To JPL OD:670-004
Telecom	F-X-1013	Notch filter	1L 2CS	1L 2CS	-	Stockroom 97B Installed	
Telecom	F-X-1014	Bandpass Filter	1L 2CS	1L 2CS	-	Stockroom 97B Installed	
Telecom	QHM-2-7.86/76173	Hybrid Coupler (SDST)	1CS	1	1	Installed	
Telecom	SM7-1213	RF, SPST Switch	1L	1	-	Stockroom 97B	
Telecom	SM7-1214	Coax Transfer Switch	1CS	1	1	Installed	Spare In Stockroom 97B
Telecom	919L3205600-009	MGA Assy, CRUISE STAGE	1CS	1	-	Installed	
Telecom	919L320XXXX-009	MGA Assy, Lander	1L	-	-	-	Not Purchased

Installed Indicates On Lander In HiBay, 1L=1 Required for Lander…, 1CS=1 Required For Cruise Stage…

Lander Hardware Status

SS	Part Number	Nomenclature	Quantity			Location	Comments
			Flt Rqd	Flt Avail	Spare		
Mech							
Mech	64852	Sep Nuts (HS to BS)	6	6	18	Stockroom 97B	Spare in Stockroom 97B
Mech	64962	Sep Nuts (Land to BS & CS To BS)	9	9	27	Stockroom 97B	Spare in Stockroom 97B
Mech	9421-600	Sep Nuts (CS SA, Leg, UHF Mech)	8	3	-	Stockroom 97B	Need Additional Sep Nuts
Mech	904ME410220-009	Dampers	2	2	1	Stockroom 97B	Spare in Stockroom 97B
Mech	Various	H/S To B/S Sep I/F	1	1	-	Installed	Spare Bolts/Springs, Load Washers
Mech	Various	Lander To B/S Sep I/F	1	1	-	Installed	Spare Bolts/Springs, Load Washers
Mech	Various	Cruise Stage To B/S Sep I/F	1	1	-	Installed	Spare Bolts/Springs, Load Washers
Mech	Various	Criuse Solar Array Hardware	1	1	-	On S/A - Hibay	Spare Bolts/Springs, Load Washers
Mech	919L380XXXX-009	MGA Two Axis Gimbal	1	-	-	-	Not Fabricated
Mech	919L3803000-009	UHF Deploy Mechanism	1	1	-	Stockroom 97B	
Struct							
Struct	919L3352300-029	Lander Body	1	1	-	Installed	
Struct	919L3355300-009	Cruise Stage	1	1	-	Installed	
Struct	919L3351000-009	Heatshield	1	1	-	Installed	
Struct	919L3352109-009	Backshell	1	1	-	Installed	
Struct	919L3352209-009	Parachute Cone	1	1	-	Installed	
Struct	919L3352409-009	Bipods	1	1	-	Installed	
Struct	919L3300009-009	Legs	2	3	-	Stockroom 97B	
Struct	Various	Miscellaneous Brackets	1	1	-	Stockroom 97B	Ballast Not Complete
Struct	9476-1	Parachute	1	-	-	-	Not Completed
Therm							
Therm	A9514-2	Lander Enclosure Heat Pipes	3	3	1	Stockroom 97B	
Therm	919L3342226	Batt Insulation	1	1	-	Stockroom 97B	
Therm	Various	MLI	1	-	-	-	Build As Needed - Material Avail
Therm	Various	Heaters	1	1	-	Avail	Most Installed, Remainder In Stockroom 97B
Therm	916FTH00026	Temp Sensors	1	1	-	Avail	Most Installed, Remainder In Stockroom 97B
Therm	Various	Thermostats	1	1	-	Avail	Most Installed, Remainder In Stockroom 97B

Installed Indicates that the Element is Installed on the Lander Body

Lander Hardware Status

SS	Part Number	Nomenclature	Quantity			Location	Comments
			Flt Rqd	Flt Avail	Spare		
Prop							
Prop	919L3500000	Propulsion top Assembly	1	1		Installed	Prop Installed On Lander Body
Prop	1601-008-01	3/8" Normally Open Pyro Valve			3	Stockroom 97B	
Prop	1852-10	Service Valve			2	Stockroom 97B	
Prop	902B3500121-010	Pressure Transducer, 4000 PSI			1	Stockroom 97B	
Prop	921A0355230-009	Pressure Transducer, 500 PSI			1	Stockroom 97B	
Prop	F0D10647-02	Filter, GHe/Hydrazine, 1/4			1	Stockroom 97B	
Prop	F1D10691-01	Filter, Hydrazine, 3/4			1	Stockroom 97B	

Installed Indicates that the Element is Installed on the Lander Body

Lander GSE Status

- **MGSE**
  - Lander MGSE Is Available
  - May Require Modifications For Specific Payload Configuration
  - System Rotation Fixture Transferred To MER: OD670:002
- **EGSE**
  - Lander EGSE Is Available
  - May Require Modifications For Specific Payload Configuration
- **System Test Lab (STL)**
  - Lander STL was Converted for Use on Odyssey Orbiter
  - 2 MSP01 STLs are in Operation and Could be used for Future Lander Applications

MSP01 Lander FSW Status

- **Last Delivery to ATLO: Build 2 01/24/2000**
  - Basic Subsystem Level Capabilities, Including Power Distribution and GNC Interfaces
- **Build 3 Partially Integrated**
  - Launch SVT: 60% Integrated
  - TCM/early Cruise SVT: 20% Integrated
  - Rev O Schematic Not Integrated
  - Rev P Schematic Not Integrated (OCA Star Camera)
  - CMD/TLM Updates Required
- **Common Code From Orbiter Available but Not Integrated**
  - OCA Star Camera
  - Multiple EPS Changes
  - Multiple Fault Protection Changes

FSW Detailed Status

- **Aeromaneuvering**
  - Development 5% Completed
- **Inertial Navigation**
  - Development 80% Completed; Algorithm Updates Required
- **Telecom**
  - Development 100% Completed
  - Needs Integration
- **Downlink (Short Frame)**
  - Development 0% Completed
  - Requirements Not Fully Defined

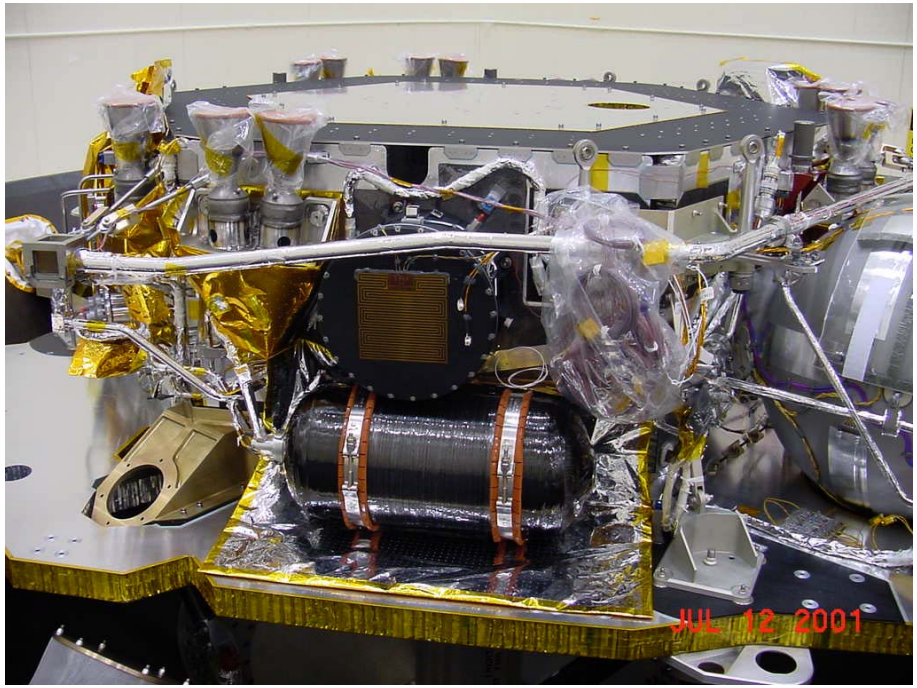
FSW Detailed Status

- EDL (Radar, Terminal Guidance & Gyrocompass)
  - Development 15% Completed; Algorithm Updates Required
- EDL (Signaling IF)
  - Development 0% Completed
  - Requirements Not Fully Defined
- MGATAG Articulation
  - Development 100% Completed
  - Needs Integration
- Schematic Rev O Implementation
  - Development 50% Completed
  - Development & Integration Effort Remaining

Storage Status

- Test Procedures and Assembly Process Procedures Stored at LMA, SSB Stockroom 97B
- Additional Documentation Maintained in LMA Flight Systems C&DM Files
- Majority of Avionics are Removed and in Special Lander Stock Room at LMA, SSB Stockroom 97B
- Lander Body, Backshell, and Heat Shield are Assembled / Bagged / Purged and Stored in Container in LMA SSB High Bay Clean Room

Configuration Photos: Storage Preps



Lander Body Inverted

Heat Shield

Configuration Photos: Storage Preps

Aeroshell Assembly

Storage Configuration
On Container Floor

Configuration Photos: Storage Preps

Bagged for Storage

Storage Configuration
SSB High Bay

Update to '01 Lander Component Status

Component	Program	Flight	Spare	EDU	Actual	Proposed	Description
SDST	MER	2	1		x		Flight Small Deep Space Transponders transferred to MER sept 2000, spare in july 2001
SSPA	SIRTF	2			x		Flight Solid State Power Amplifiers transferred to SIRTF
Thermal Battery	MER	1	4		x		5 thermal batteries transferred to Eagle Picher (for JPL) (all are flight quality, need several for testing)
UHF Xcver	MER	2			x		Flight UHF xceivers transferred to MER
X Band Diplexer	JPL		1		x		1 spare x band diplexer transferred to JPL
Li-Ion Battery	JPL	2	1	2	x		Batteries transferred to JPL, GRC, NRL, AFRL
IMU	MRO		1			x	Odyssey/Lander spare IMU requested by MRO
LGA Patch Antennas	MRO		2			x	Patch Low Gain Antennas requested by MRO (flight LGA's still on lander cruise stage)
MR-107 Thrusters	MRO	7				x	7 lander descent thrusters requested by MRO
PIU	MRO	1	1			x	Flight and EDU Pyro Initiator Unit are on MRO GFP list, not yet formally requested
DC/DC Converter	MRO	2	1			x	C&DH, PDDU, and spare DC/DC converters on MRO GFP list, not yet formally requested
Sun Sensor	MRO		1			x	Spare Sun sensor on MRO GFP list, not yet formally requested
Flight Processor Card	SIRTF	1				x	Request for a flight processor card by SIRTF, may provide STL card or Genesis spare
Temperature Sensors	MRO	#			x		Stock temperature sensors, replaced easily for Scout in future

Large quantities of ground support and test equipment, materials, and engineering units are planned for transfer to MRO done from MSP98 to MSP01.
It is expected that most of that equipment would be transferred back to an 07 scout mission using the lander, with the exception of consumables (MLI, heaters, etc.) or items destroyed or damaged.

Use of the MSP'01 Lander for Flight in '07

Additional Data for Proposers

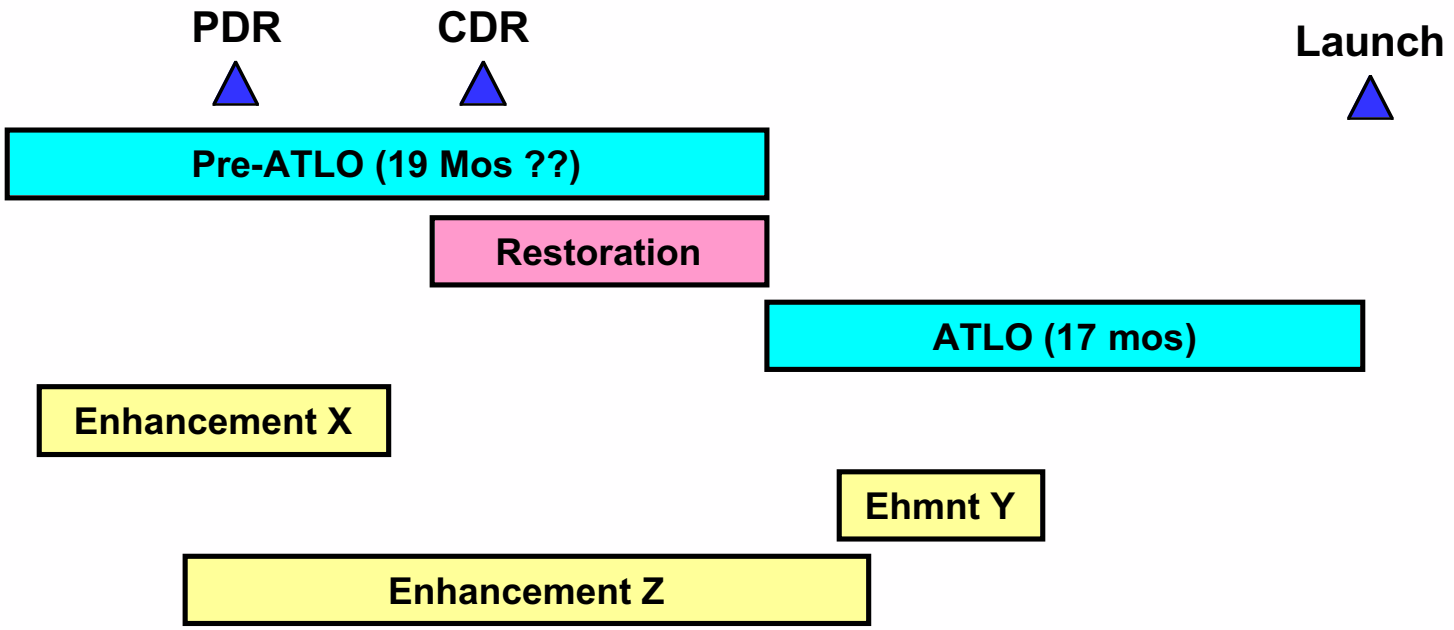
LMAO

What Must Be Done To Use the '01 Lander in '07

- **Four flavors of tasks must be done to fly the '01 lander in any opportunity other than the 2001 Type II and with any payloads other than were baselined at the end of November 1999**
  - **Restoration – Bring the lander back to state it was in when work was stopped**
    - » **MER, SIRTF, and MRO have taken possession of some flight hardware and GSE**
    - » **Some Lander subcontracts were stopped prior to completion**
    - » **Teardown restoration**
    - » **Storage extraction**
  - **Pre-ATLO**
    - » **"Generic" payload accommodation for new payloads**
    - » **Minimum analyses for new mission parameters across all subsystems**
    - » ****Design changes required because of the new opportunity****
    - » ****Mission/payload unique accommodations****
  - **ATLO**
    - » **Take restored lander through integration and test to the launch pad**
  - **Enhancements**
    - » **Previously identified changes to address MPL failure related issues or other functional or performance enhancements**
    - » ****Changes to address MPL failure related changes or other functional or performance enhancements NOT PREVIOUSLY STUDIED****
- **With qualifying assumptions, all these efforts can be estimated EXCEPT those marked with double asterisks **. These ** efforts are unique to each Scout proposal.**

Phasing of Tasks

- With the exception of ATLO, there is considerable flexibility in duration and start times for the other efforts



Restoration – cont.

- **The following subcontracts were terminated prior to completion and must be completed**
  - **The Li-Ion flight batteries were not fabricated. The test units were delivered to PRDA. New test, spare and flight batteries must be procured.**
  - **The flight parachute was not fabricated. The test program must be completed and the flight chute fabricated and delivered**
  - **The landed solar arrays were delivered prior to rework and final acceptance test. These tasks must be completed**
  - **The UHF diplexer was not completed**
- **The following tasks must also be done to bring the lander back to a state where ATLO can proceed**
  - **Harness replacement**
    - » **The lander harness was cut up and was to be re-built, but work was stopped three days into this process**
  - **Storage extraction**
    - » **The lander is stacked in the launch configuration. It must be torn down to its basic four elements to allow ATLO to proceed and integrate the previously removed boxes and any payloads**
  - **Box requalification**
    - » **The C&DH, PDDU, and CBU must be re-ATP'd as they were either in rework when work was stopped or were disassembled and used for Odyssey testing**

ATLO

- **Because of the restoration, most of the lander tests completed by the time work was stopped will have to be rerun**
  - **Tests that must be partially or completely re-run**
    - » **Battery/CCU/SAS IF Test**
    - » **Pyro Performance Test**
    - » **Abbreviated System Test #1**
    - » **DSN Compatibility Test**
    - » **Bus Functional**
  - **Tests that MAY have to be re-run**
    - » **Landing radar test may have to be re-run if any mods are made to the radar**
    - » **REM functional test will have to be re-run if MRO takes engines or any other prop mods are made**

- **ATLO is assumed to be 17 months**
  - **Includes 2.5 months schedule margin**

Pre-ATLO

- **Example tasks required for a Scout proposal:**
  - **Payload accommodation for new payload**
    - » **Assumes all payloads can be accommodated within the existing resources of the lander as they will perform in the new opportunity**
    - » **Includes modeling any layout changes**
    - » **Includes ICD development**
    - » **Includes software support**
    - » **Mission analysis to characterize capabilities of present system in new environments (impacts of choosing a landing site at a different latitude than was originally intended, for example)**
  - **Minimum analyses for new mission parameters across all subsystems**
    - » **Because the lander is being flown in an opportunity for which it has not been designed, all mission parameters must be re-analyzed to determine if the performance will change or if design changes are needed**
    - » **Examples include**
      - **New power analysis for new sun ranges**
      - **New thermal analysis for new Ls and latitude**
      - **New link analysis for new Earth ranges and SPE's**
      - **EDL analysis (g-loads, TPS thickness, payload mass capability) for new arrival conditions**
  - **Software will be completed and delivered at the start of ATLO**

Pre-ATLO

- This represents a “floor” of design effort. Depending on the mission, more effort may be required. It is not likely that less effort will be required.
- There are still many factors that could influence pre-ATLO, and it will be highly dependent on the exact mission. Some assumptions include:
  - 19 month pre-ATLO assumed. The lander is flexible, either shorter or longer schedule can be accommodated, with some minor impacts to cost
    - » Late starts to fit tight funding profiles
    - » Early starts to complete optional risk reduction measures early
  - No synergies with other programs are assumed.
  - The design effort is “typical” of LMAO experience from MSP’98, MSP’01 lander and orbiter (Odyssey), Stardust and Genesis, particularly the ’01 lander.
  - The original lander baseline requirements are assumed, including precision landing/aeromaneuvering

Enhancements

- There are many enhancements that have either been recommended by various review boards or studied for other reasons. Those that have been studied are presented here. Each PI must determine if any of these changes will be incorporated into a scout mission
- In most cases, if the enhancement addressed a potential MPL failure mode, the implementation assumed is that which was reviewed by the Return to Flight Board
- Some options require that another be implemented first
- Some options are mutually exclusive of one another

Potential Enhancements

	Performance Increase	Risk Reduction
• Viking engines	X	X
• Cruise stage solar array increase*	X	
• Landed solar array increase	X	
• Direct-to-Earth link	X	X
• EDL communications	X	
• Radar Modifications	X	X
• Cruise Stage Propulsion	X	X
• Hot Fire Test Bed		X
• Hazard Avoidance	X	X
• CG Control Propulsion Mod		X
• Slosh Characterization Test		X
• Radar Drop Test		X
• IV&V (“break the system” testing)		X
• Plume/soil interaction characterization		X
• Landing robustness modifications	X	X
• Additional analyses and tests		X

*Analysis of the 07 opportunity has shown that an increase in cruise array will likely be needed because of the greater sun range at arrival